Claims

1 A method for tracking the position of an object surface, including generating an interference signal between light beams of short temporal coherence length respectively comprising a primary beam reflected or scattered from the object surface and a reference beam, scanning a reference surface in the path of said reference beam about a position at which said interference signal is generated, which position is thereby indicative of the position of the object surface, and controlling said position of said reference surface to maintain a predetermined point in the range of said scanning at the indicative position.

2 A method according to claim 1 wherein said light beams of short temporal coherence length are derived by splitting a single initial beam.

3 A method according to claim 2 wherein said splitting is effected at a beamsplitter at which the interference signal is formed by return of said light beams.

4 A method according to claim 1, ~~2 or 3~~ wherein said reference surface comprises reflection or scattering means.

5 A method according to claim 1 ~~any preceding claim~~ further including modulating said interference signal with a characteristic predetermined repetitive variation.

6 A method according to claim 5 wherein said modulation is effected by additionally dithering the position of the reference surface.

7 A method according to claim 1 ~~any preceding claim~~ wherein said control of said position of the reference surface is effected by dithering the reference surface about a location at which a peak interference signal is detected,

and maintaining said predetermined point at the indicative position in response to said peak interference signal.

8 A method according to ~~any preceding claim~~ claim 1 wherein said object is the cornea or iris of an eye.

9 A method of performing a surgical procedure at a sequence of points in tissue, wherein the correct location of said points is maintained by tracking the position of a related object surface according to ~~any one of claims 1 to 8~~ claim 1.

10 A method according to claim 9 wherein said surgical procedure is a surgical laser procedure in which a laser beam is focused successively at said points in the tissue.

11 A method according to claim 10 wherein said surgical procedure comprises one or more of intrastromal photorefractive keratectomy, Laser-in-situ-Keratomileusis procedures or laser optical breakdown in phacoemulsifaction.

12 A method for tracking the position of an object surface, including generating an interference signal between light beams of short temporal coherence length respectively comprising a primary beam reflected or scattered from the object surface and a reference beam, scanning a reference surface in the path of said reference beam about a position at which said interference signal is generated, which position is thereby indicative of the position of the object surface, and modulating said interference signal with a characteristic predetermined repetitive variation.

13 A method according to claim 12 wherein said modulation is effected by additionally dithering the position of the reference surface.

14 A method according to claim 12 or ~~13~~ wherein said light beams of short temporal coherence length are derived by splitting a single initial beam.

15 A method according to claim 14 wherein said splitting is effected at a beamsplitter at which the interference signal is formed by return of said light beams.

16 A method according to ~~any one of claims 12 to 15~~ claim 12 wherein said reference surface comprises reflection or scattering means.

17 A method according to any one of claims 12 to 16 wherein said object is the cornea or iris of an eye.

18 A method of performing a surgical procedure at a sequence of points in tissue, wherein the correct location of said points is maintained by tracking the position of a related object surface according to ~~any one of claims 12 to 17~~ claim 16.

19 A method according to claim 18 wherein said surgical procedure is a surgical laser procedure in which a laser beam is focused successively at said points in the tissue.

20 A method according to claim 19 wherein said surgical procedure comprises one or more of intrastromal photorefractive keratectomy, Laser-in-situ-Keratomileusis procedures or laser optical breakdown in phacoemulsifaction.

21 Apparatus for tracking the position of an object surface, including:

interferometer means for generating an interference signal between light beams of short temporal coherence length respectively comprising a primary beam reflected or scattered from the object and a reference beam;

a reference surface in the path of said reference beam;

means for scanning said reference surface about a position at which said interference signal is generated, which position is thereby indicative of the position of the object surface; and

means for controlling said position of said reference surface to maintain a predetermined point in the range of said scanning at the indicative position.

22 Apparatus according to claim 21 wherein said interferometer means includes a source of an initial beam and means for deriving said light beams of short temporal coherence length by splitting said initial beam.

23 Apparatus according to claim 22 wherein said source is a superluminescent diode.

A 24 Apparatus according to ~~claims 22 and 23~~ claim 22 wherein said interferometer means further includes a beamsplitter for effecting said splitting and at which the interference signal is formed by returned of said light beams.

A 25 Apparatus according to ~~any one of claims 21 to 24~~ claim 21 wherein said reference surface comprises reflection or scattering means.

A 26 Apparatus according to ~~any one of claims 21 to 25~~ claim 21 further including means to modulate said interference signal with a characteristic predetermined repetitive variation.

27 Apparatus according to claim 26 wherein said modulation means includes means to additionally dither the position of said reference surface.

A 28 Apparatus according to ~~any one of claims 21 to 27~~ claim 21 wherein said controlling means includes means to dither said reference surface about a location at

which a peak interference signal is detected, and to maintain said predetermined point at the indicative position response to said peak interference signal.

29 Apparatus according to ~~any one of claims 21 to 28~~ claim 21 configured for tracking the position of the surface of the cornea or iris of an eye.

30 Surgical apparatus for performing a surgical procedure at a sequence of points in tissue, including tracking apparatus according to ~~any one of claims 21 to 29~~ claim 21 for maintaining the correct location of said points by tracking the position of a related object surface.

31 Apparatus according to claim 30 wherein said surgical procedure is a surgical laser procedure and said apparatus includes a source of a laser beam and means to focus the laser beam successively at said points in the tissue.

32 Apparatus according to ~~any one of claims 21 to 31~~ claim 21 wherein said scanning means comprises one or more of resonant, piezo or galvanometer scanning means.

33 An apparatus according to ~~any one of claims 21 to 32~~ claim 21 wherein said detecting means includes a silicon diode detector.

34 Apparatus for tracking the position of an object surface, including:

interferometer means for generating an interference signal between light beams of short temporal coherence length respectively comprising a primary beam reflected or scattered from the object and a reference beam;

a reference surface in the path of said reference beam;

means for scanning said reference surface about a position at which said interference signal is generated, which position is thereby indicative of the position of the object surface; and

means to modulate said interference signal with a characteristic predetermined repetitive variation.

35 Apparatus according to claim 34 wherein said modulation means includes means to additionally dither the position of said reference surface.

A 36 Apparatus according to claim 34 or ~~35~~ wherein said interferometer means includes a source of an initial beam and means for deriving said light beams of short temporal coherence length by splitting said initial beam.

37 Apparatus according to claim 36 wherein said source is a superluminescent diode.

A 38 Apparatus according to ~~claims 36 and 37~~ claim 36 wherein said interferometer means further includes a beamsplitter for effecting said splitting and at which the interference signal is formed by returned of said light beams.

A 39 Apparatus according to ~~any one of claims 34 to 38~~ claim 34 wherein said reference surface comprises reflection or scattering means.

A 40 Apparatus according to ~~any one of claims 34 to 39~~ claim 34 wherein said controlling means includes means to dither said reference surface about a location at which a peak interference signal is detected, and to maintain said predetermined point at the indicative position response to said peak interference signal.

A 41 Apparatus according to ~~any one of claims 34 to 40~~ claim 34 configured for tracking the position of the surface of the cornea or iris of an eye.

42 Surgical apparatus for performing a surgical procedure at a sequence of points in tissue, including tracking apparatus according to ~~any one of claims 34 to 41~~ claim 34 for maintaining the correct location of said points by tracking the position of a related object surface.

43 Apparatus according to claim 42 wherein said surgical procedure is a surgical laser procedure and said apparatus includes a source of a laser beam and means to focus the laser beam successively at said points in the tissue.

44 Apparatus according to ~~any one of claims 34 to 43~~ claim 34 wherein said scanning means comprises one or more of resonant, piezo or galvanometer scanning means.

45 An apparatus according to ~~any one of claims 34 to 44~~ claim 34 wherein said detecting means includes a silicon diode detector.